COMM 3 Controller Integration Requirements Document

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National Aeronautics and Space Administration
Armstrong Flight Research Center

COMM 3 Controller Integration Requirements Document

APPROVALS

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Table of Contents

COMM 3 Controller Integration
Requirements Document

1.0 SCOPE

Arcata, Inc. prepared this requirements document on behalf of the National Aeronautics and Space Administration (NASA) at the Armstrong Flight Research Center (AFRC)

This document covers the requirements for COMM 3 Controller Integration. This will be utilized by NASA AFRC Communications Facility as the COMM 3 UHF high-gain transceiving system for support of missions requiring high-gain communications such as Human Space Flight operations utilizing Low Earth Orbiting Vehicles and long range aeronautical research missions. This requirements document is for the integration of the following Government Furnished Equipment (GFE): Rotating Precision Mechanisms (RPM), Inc. Pedestal, Telemetry & Communications Systems (TCS) Inc., Antenna Control Unit (ACU)-M1, TCS Pedestal Interface Unit (PIU) enclosure, TCS Servo Amplifier/Power Supply/Motor System (aka servo drive system) and TCS Boresight Camera System. The part number for the Camera System is 304766-J1214. The camera shall be a NTSC 36X camera with a focal length of 3.3 millimeters to 119 millimeters with automatic and manual zoom and focus. Hereafter in this document these integrated systems will be referred to as the COMM 3 Controller Integration. The COMM 3 Controller Integration is operated in adverse environmental conditions and is used for mission critical applications and therefore it must be highly reliable.

2.0 APPLICABLE DOCUMENTS

2.1 Government Documents

2.1.1 MIL-STD-810E, Environmental Test Methods and Engineering Guidelines

2.1.2 NASA Policy Directive (NPD) 8730.5B, NASA Quality Assurance Policy

2.2 Non-Government Documents

2.2.1 IPC/J-STD-001ES, Standard for Soldered Electrical Connections

2.2.2 AS9100, Quality Management System Standard

2.2.3 ISO 10012, Quality Assurance Requirements for Measuring Equipment

2.2.4 American National Standard Institute (ANSI) ANSI/ESD-S20.20, Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronics Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

2.2.5 American National Standard Institute for Electric Power Systems and Equipment (ANSI C84.1)

2.2.6 American National Standard Institute (ANSI) / National Conference of Standards Laboratories (NCSL) Z540.1, General Requirements for Calibration Laboratories and Measuring Equipment and Test Equipment

2.3 Order of Precedence

In the event of a conflict between the text of this specification and the references cited herein, the text of this document takes precedence. However, nothing in this specification supersedes applicable laws and regulations.

3.0 REQUIREMENTS

The COMM 3 Controller Integration shall meet the performance specified in Section 3.1 under the environmental exposure conditions specified in Section 3.3.

3.1 Electrical Performance

3.1.1 Input Voltage

The COMM 3 Controller Integration of the Antenna Control Unit-M1 (ACU-M1) shall operate from a single phase 120 Volt AC (VAC) power source that meets the requirements specified in the American National Standard for Electric Power Systems and Equipment (ANSI C84.1). The COMM 3 Controller Integration of the T-Head, PIU and servo drive system shall operate from a three phase 208 VAC power source that meets the requirements specified in ANSI C84.1. The COMM 3 Controller Integration of the Camera System shall operate from single phase 120 VAC power source that meets the requirements specified in ANSI C84.1. NASA AFRC will provide the 120/208 utility power.

3.1.2 Current

The current consumption of COMM 3 Controller Integration (ACU-M1) shall not be greater than 5 amperes single phase. The current consumption of COMM 3 Controller Integration pedestal, PIU and servo drive system shall not be greater than 60 amperes across all three phases.

3.2 COMM 3 Controller Integration Requirements

3.2.1 Delivery of GFE Hardware to Vendor

If the vendor's facility is more than 200 miles from NASA AFRC the vendor shall provide shipping of the GFE from NASA AFRC to their location for the COMM 3 Controller Integration factory integration. The shipping cost shall be provided in the vendor's proposal. If the vendor's facility is less than 200 miles from NASA AFRC NASA will provide shipping to the vendor's facility. The GFE is as follows:

a. R.P.M. Pedestal T-Head (P/N PG2504A, S/N 003, and ECN 1976921), hereafter referred to as the T-Head.

b. TCS ACU-M1 antenna controller (P/N 300110-J1151, S/N A1153, and ECN 3064891)

c. TCS PIU (P/N 115110-01, S/N S1008)

d. TCS azimuth servo drive system (P/N 304469-01)

e. TCS elevation servo drive system (P/N 304469-01)

3.2.2 Integration Summary

The COMM 3 Controller Integration vendor shall successfully perform factory integration and Acceptance Test Procedure (ATP) at their facility (detailed in Section 3.2.4 of this document) of the following equipment:

a. GFE R.P.M. T-Head including its integrated components

b. GFE TCS PIU

c. GFE TCS ACU-M1 antenna controller

d. GFE TCS azimuth and elevation servo drive system

e. Camera System, including copper to fiber conversion of video signal

f. Pedestal Remote Control Utility Box

3.2.3 Return COMM 3 Controller Integration to NASA AFRC

If the vendor's facility is more than 200 miles from NASA AFRC the vendor shall provide shipping to NASA AFRC of the GFE hardware identified in Section 3.2.1 and the vendor supplied associated hardware and software from the vendor's facility after factory

integration and ATP has been successfully completed. The shipping cost shall be provided in the vendor's proposal. If the vendor's facility is less than 200 miles from NASA AFRC NASA will provide shipping back to NASA AFRC.

3.2.4 Integration Details

The COMM 3 Controller Integration vendor shall meet the following requirements during the integration.

3.2.4.1 Slip Ring Package

The vendor shall provide a slip ring package that meets or exceeds the COMM 3 Controller Integration requirements. The slip ring requirements shall consist of a minimum of 44 rings.

3.2.4.2 Servo Drive System

NASA AFRC shall provide GFE servo drive system for the azimuth and elevation axis drives. Both azimuth and elevation servo drive systems shall be integrated with the GFE PIU. The servo drive system shall be capable of driving the azimuth and elevation axis at the maximum rated velocity (20 degrees/second) and acceleration (20 degrees/second squared). The existing GFE drive motors shall be removed from the GFE T-Head and returned to NASA AFRC no later than one week after successful on-site ATP.

3.2.4.3 Servo Operational Wind Loading

The GFE Pedestal including the GFE 20 foot diameter solid composite reflector with the new servo drive system shall maintain the minimum velocity of 10 degrees/second and acceleration of 10 degrees/second squared at an average wind speed up to 35 MPH and wind gusts up to 50 MPH. While the servo drive system is active, the pedestal and reflector shall maintain pointing accuracy within +/- 0.1 degrees. The brake assembly shall hold the pedestal and reflector in winds up to 35 MPH. The vendor shall successfully simulate the servo wind load operational survivability testing during their facility ATP and provide the results to NASA as part of the factory ATP results. NASA AFRC understands that the weather conditions may prohibit servo wind load operational survivability testing during the customer on-site ATP of the COMM 3 Controller Integration.

3.2.4.4 Pedestal Interface Unit (PIU) Repackaging/Upgrades

The vendor shall repackage the GFE PIU with the servo drive system. The vendor shall bring the PIU up to the latest revision of hardware and firmware. The PIU / servo drive system shall be packaged in a vendor supplied enclosure which must be

mounted inside of the equipment rack (W= 19”, Depth= 24”, Height= 36”) inside the pedestal on Building 4870 at NASA AFRC.

3.2.4.5 Antenna Control Unit (ACU) Upgrades

The vendor shall upgrade the GFE ACU-M1 Antenna Controller hardware, firmware and software to be the most current revision. The vendor shall configure the ACU-M1 to meet NASA AFRC requirements. The ACU-M1 will be located in Building 4824 at NASA AFRC and connect to the PIU utilizing fiber optic multimode fiber.

3.2.4.6 System Cabling and Hardware

The vendor shall provide cabling and hardware between the GFE Pedestal, GFE servo drive system, the GFE camera, GFE 3 channel rotary joint, slip ring assembly and all the pedestal connections, data packs, limit switches, encoders/synchros, brake release switches, interlock switches, etc.

3.2.4.7 Fiber Optics Connectivity

The distance between the ACU-M1 and the PIU is approximately 400 feet. NASA AFRC will furnish the fiber optic connectivity necessary to allow the GFE PIU and the GFE camera to communicate with the GFE ACU-M1 Antenna Controller.

3.2.4.8 T-Head Head Riser

The GFE T-Head riser is 115 inches from its base to the top of the GFE elevation head. The pedestal riser and T-Head will be located on the roof of Building 4870 at NASA AFRC.

3.2.4.9 T-Head Remote Control Utility Box

The vendor shall provide a means to remotely control the T-Head servo system using a control box connected to the PIU. The control box cable shall be a minimum of 50 feet in length.

3.2.5 T-Head Weight Distribution and Balance

The GFE T-Head not including the riser and reflector weighs approximately 2000 pounds. After NASA AFRC personnel complete the installation of the COMM 3 Controller Integration and 20 foot reflector at NASA AFRC building 4870, the vendor shall travel to NASA AFRC to tune the system including, payload weight distribution and balancing. This function is an integral part of assuring the integration has been completed in compliance with the requirements of this document.

3.2.6 ACU-M1 Coefficient and Servo Drive System Tuning

The vendor shall tune the ACU-M1 Antenna Controller as required to assure that the ACU is properly tuned for COMM 3 Controller Integration payload. The servo drive system shall be tuned as required to assure that the servo drive system is operating efficiently and the current limits and servo balancing is set to optimal performance.

3.3 Environmental Requirements

3.3.1 Temperature

The COMM 3 Controller Integration shall meet the performance requirements specified in Section 3.1 while exposed to external temperatures ranging from +5 degrees F to + 122 degrees F.

3.3.2 Humidity

The COMM 3 Controller Integration shall meet the performance requirements specified in 3.1 during and after exposure to relative humidity of 95 percent at a maximum temperature of +122 degrees F.

3.4 Design and Construction

3.4.1 Materials and Processes

The materials and processes used in manufacture of the COMM 3 Controller Integration system shall be appropriate for the intended application.

3.4.2 Standards of Manufacture

3.4.2.1 Product Cleanliness

No oils or solid lubricants of any kind shall be used on any part of the COMM 3 Controller Integration after final cleaning.

3.4.2.2 Soldering

Procedures and requirements for preparation and soldering of electrical connections shall be in accordance with IPC/J-STD-001ES, Standard for Soldered Electrical Connections.

3.4.2.3 Working Environment

The vendor shall provide adequate facilities for the fabrication, assembly, and testing of COMM 3 Controller Integration.

4.0 VERIFICATION

4.1 Acceptance Testing

The vendor shall perform factory and customer on-site ATP on entire system to be delivered.

4.1.1 Acceptance Test Requirements

The vendor shall electronically deliver to NASA for review the factory ATP documentation for the Comm 3 Controller Integration a minimum of one week in advance of the planned factory ATP. The vendor shall provide a minimum of one week's notice to NASA prior to vendor's factory ATP. NASA personnel will review and provide feedback on the factory ATP documentation prior to the factory ATP being performed. NASA personnel will witness, verify, approve and sign off on the factory ATP. The onsite ATP shall be conducted at NASA AFRC Building 4870 once assembly and installation is complete. The vendor shall deliver to NASA for review detailed customer on-site ATP documentation a minimum of one week prior to the customer on-site ATP. The vendor shall perform an on-site ATP of all the GFE and vendor supplied associated hardware and software. NASA personnel will witness, verify, approve and sign off on the on-site ATP. The vendor's work shall result in an operational system that meets or exceeds NASA AFRC's requirements and specifications.

4.1.2 Acceptance Test Data

Factory ATP data (results) and onsite ATP data shall be electronically delivered to a NASA representative within 10 days of successful completion of each ATP.

4.2 Quality Assurance

The vendor shall have a quality management system in place that complies with the quality system requirements of AS9100 or ISO9001 and NASA Quality Assurance Program Policy, NPD 8730.5B.

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4.2.1 The Equipment and Inspection Facilities

The vendor shall ensure that test and inspection facilities of sufficient accuracy, quality, and quantity are established and maintained to conduct the required testing and inspections.

4.2.2 Calibration System

The vendor shall have a documented calibration system that meets the requirements of ISO 10012, Quality assurance requirements for measuring equipment, or the American National Standard Institute (ANSI) / National Conference of Standards Laboratories (NCSL) Z540-1, General Requirements for Calibration Laboratories and

Measuring Equipment and Test Equipment standards.

4.2.3 Inspections and Data Requirements

The vendor shall perform all required inspections and tests to ensure that all articles and materials conform to requirements and applicable drawings and specifications. Such inspections and tests shall encompass the receiving, processing, fabrication, assembly, end-item and shipping phases.

4.2.4 Electrical / Electronic Articles and Materials

The vendor shall develop an approved method of detecting counterfeit parts and a way of permanently removing them from the Electrical, Electronic and Electromechanical (EEE) parts purchasing network. The vendor shall notify NASA QA of any identification of counterfeit parts used in manufacturing or found in receiving inspection.

4.2.5 Electrostatic Discharge (ESD) Protection Program

The vendor shall document and implement an ESD control program based on ANSI/ESD S20.20, ESD Association Standard for the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices). Parts must be properly packaged and identified as required in ANSI/ESD-S20.20. When applicable all goods will be placed in conductive or static-dissipative packages, tubes, carriers, conductive bags, etc., for shipment. The packaging must be clearly labeled to indicate that it contains electrostatic sensitive goods. Electrical parts that may be used or shipped in conjunction with ESD sensitive parts shall be treated as ESD sensitive.

4.2.6 Verification of Serviceability

The vendor shall include a tag, label or similar instrument stating that the materials delivered are serviceable.

5.0 HARDWARE DELIVERY

5.1 Certificate of Conformance

The vendor shall deliver a certificate of conformance along with the delivery of the COMM 3 Controller Integration.

5.2 Documentation

The vendor shall deliver all required documentation to NASA electronically to include two copies of user manuals or other documents including schematics, drawings, photographs, etc. to enable NASA and NASA personnel to perform field level maintenance of the COMM 3 Controller Integration system.

6.0 WARRANTY

The vendor shall provide a minimum of a one year warranty on parts, materials and workmanship.

7.0 ACRONYMS

AC	Alternating Current
ACU	Antenna Control Unit
AFB	Air Force Base
ANSI	American National Standard Institute
AFRC	Armstrong Flight Research Center
AOP	Armstrong Organizational Procedure
ASTM	American Society for Testing and Materials
ATP	Acceptance Test Plan / Procedure
Comm	Communications
DATR	Dryden Aeronautical Test Range
Deg	Degrees
EEE	Electrical, Electronic and Electromechanical
EMI	Electro-Magnetic Interference
ESD	Electro Static Discharge
F	Fahrenheit
ISO	International Organization for Standardization
MIL	Military
MIL-STD	Military Standard
MPH	Miles Per Hour
NASA	National Aeronautics and Space Administration
NCSL	National Conference of Standards Laboratories
PIU	Pedestal Interface Unit
QA	Quality Assurance
R.P.M	Rotating Precision Mechanisms, Inc.
SOW	Statement Of Work
STD	Standard
TCS	Telemetry & Communications Systems
V	Volts
VAC	Volts alternating current
Ver	Version